

In The Claims

Add new claims 17-21 as set forth below, and amend the original claims, as indicated below. The current status of each claim is shown in the complete list of claims 1-21 below.

1. (currently amended) An apparatus for collecting and redistributing to a layer of structured packing disposed in an exchange column a first flow of a liquid descending in an on or near an inner wall of the exchange column, the exchange column having a longitudinal axis, and a cross-sectional area, and an the inner wall having an inner perimeter, and the exchange column containing at least one layer of structured packing having an exterior surface spaced apart from the inner perimeter of the inner wall, comprising:

a wall-flow collector disposed in the exchange column above the layer of structured packing, the wall-flow collector having an outer perimeter adjacent the inner perimeter of the inner wall and being adapted to collect at least a portion of the liquid in the first flow of the liquid descending on or near the inner wall of the exchange column without collecting a substantial portion of the liquid in a second flow of the liquid descending in the exchange column away from the inner wall;

a transmission means disposed in the exchange column for transmitting at least a portion of the collected liquid collected by the wall-flow collector toward the longitudinal axis away from the inner perimeter of the inner wall a substantial distance across the cross-sectional area of the exchange column; and

a dispensing means for dispensing at least a portion of the portion of the collected liquid from the transmission means to the layer of structured packing at a plurality of locations spaced apart over the substantial distance across the cross-sectional area of the exchange column.

2. (currently amended) An apparatus as in claim 1, wherein

the transmission means comprises at least one trough in fluid communication with the wall-flow collector, the trough extending across at least a portion of the cross-sectional area of the exchange column, and

the dispensing means comprises a plurality of apertures or overflow notches in the at least one trough near a plurality of the plurality of locations at least one aperture or overflow notch in each trough.

3. (currently amended) An apparatus as in claim 2, further comprising at least one wiper adjacent the inner perimeter of the inner wall of the exchange column or the exterior surface of the structured packing, the wiper being located above the trough and adapted to transfer at least a portion of the liquid in the first flow of the liquid descending on or near the inner wall into the trough.

4. (withdrawn) An apparatus as in claim 1, wherein

the transmission means comprises a plate, at least a portion of the plate being in fluid communication with the wall-flow collector, the plate extending across at least a portion of the cross-sectional area of the exchange column, and

the dispensing means comprises at least one aperture in the plate.

5. (withdrawn) An apparatus as in claim 1, wherein

the transmission means comprises at least one extended wiper attached to the wall-flow collector, the extended wiper penetrating across at least a portion of the cross-sectional area of the column toward the longitudinal axis.

6. (original) An apparatus as in claim 1, wherein the wall-flow collector is fixedly attached to the inner wall of the exchange column.

7. (original) An apparatus as in claim 1, wherein the wall-flow collector is moveable in a vertical direction along the longitudinal axis within the exchange column.

8. (currently amended) An apparatus for collecting and redistributing to a first layer of structured packing disposed in an exchange column a first flow of a liquid descending in an on or near an inner wall of the exchange column, the exchange column having a longitudinal axis, and a cross-sectional area, and an the inner wall having an inner perimeter; and the exchange column containing a the first layer of structured packing and a second layer of structured packing above the first layer of structured packing, each of the first and second layers of structured packing having an exterior surface spaced apart from the inner perimeter of the inner wall, comprising:

a wall-flow collector disposed in the exchange column above the first layer of structured packing and below the second layer of structured packing, the wall-flow collector having an outer perimeter adjacent the inner perimeter of the inner wall and being adapted to collect at least a portion of the liquid in the first flow of the liquid descending on or near the

inner wall of the exchange column without collecting a substantial portion of the liquid in a second flow of the liquid descending in the exchange column away from the inner wall; and

at least one member disposed in the exchange column between the first layer of structured packing and the second layer of structured packing, each member adapted to support at least a portion of the second layer of structured packing and to transmit at least a portion of the collected liquid collected by the wall-flow collector toward the longitudinal axis away from the inner perimeter of the inner wall a substantial distance across the cross-sectional area of the exchange column.

9. (currently amended) An apparatus as in claim 8, further comprising:

at least one aperture a plurality of apertures in each member for dispensing at least a portion of the collected liquid from the member to the first layer of structured packing at a plurality of locations spaced apart over the substantial distance across the cross-sectional area of the exchange column.

10. (original) An apparatus as in claim 8, wherein the member is a beam having a first end, a second end opposite the first end, and an elongated channel between the first end and the second end, the elongated channel being in fluid communication with the wall-flow collector.

11. (currently amended) An apparatus for collecting and redistributing a flow of a liquid descending in an exchange column having a longitudinal axis, a cross-sectional area, and an inner wall having an inner perimeter, the exchange column containing a first layer of structured packing and a second layer of structured packing above the first layer of structured packing, each of the first and second layers of structured packing having an exterior surface spaced apart from the inner wall, comprising:

a wall-flow collector disposed in the exchange column above the first layer of structured packing and below the second layer of structured packing, the wall-flow collector being fixedly attached to the inner wall and adapted to collect at least a portion of the liquid descending on or near the inner wall of the exchange column;

at least one beam disposed in the exchange column between the first layer of structured packing and the second layer of structured packing, each beam adapted to support at least a portion of the second layer of structured packing and each beam having a first end, a second end opposite the first end, and an elongated channel, having an open top

and a floor, between the first end and the second end, the elongated channel being in fluid communication with the wall-flow collector and adapted to transmit at least a portion of the collected liquid collected by the wall-flow collector toward the longitudinal axis a substantial distance across the cross-sectional area of the exchange column;

at least one aperture in the floor of the channel of each beam for dispensing at least a portion of the collected liquid from the channel of the beam to the first layer of structured packing; and

at least one wiper adjacent the inner wall of the exchange column or the exterior surface of the structured packing, the wiper being located above the beam and adapted to transfer at least a portion of the liquid descending on or near the inner wall into the channel of the beam.

12. (currently amended) An apparatus for collecting and redistributing a flow of a liquid descending in an exchange column having a longitudinal axis, a cross-sectional area, and an inner wall having an inner perimeter, the exchange column containing a first layer of structured packing and a second layer of structured packing above the first layer of structured packing, each of the first and second layers of structured packing having an exterior surface spaced apart from the inner wall, comprising:

a wall-flow collector disposed in the exchange column above the first layer of structured packing and below the second layer of structured packing, the wall-flow collector being movable in a vertical direction along the longitudinal axis within the exchange column and adapted to collect at least a portion of the liquid descending on or near the inner wall of the exchange column;

at least one beam disposed in the exchange column between the first layer of structured packing and the second layer of structured packing, each beam adapted to support at least a portion of the second layer of structured packing and each beam having a first end, a second end opposite the first end, and an elongated channel, having an open top and a floor, between the first end and the second end, the elongated channel being in fluid communication with the wall-flow collector and adapted to transmit at least a portion of the collected liquid collected by the wall-flow collector toward the longitudinal axis a substantial distance across the cross-sectional area of the exchange column;

at least one aperture in the floor of the channel of each beam for dispensing at least a portion of the collected liquid from the channel of the beam to the first layer of structured

packing; and

at least one wiper adjacent the inner wall of the exchange column or the exterior surface of the structured packing, the wiper being located above the beam and adapted to transfer at least a portion of the liquid descending on or near the inner wall into the channel of the beam.

13. (currently amended) An exchange column for exchanging heat and/or mass between a an ascending vapor and a liquid descending in the exchange column having a longitudinal axis, a cross-sectional area, and an inner wall having an inner perimeter, the exchange column containing a group of internals, comprising:

at least one layer of structured packing having an exterior surface spaced apart from the inner perimeter of the inner wall;

a wall-flow collector above the layer of structured packing, the wall-flow collector having an outer perimeter adjacent the inner perimeter of the inner wall and being adapted to collect at least a portion of the liquid in a first flow of the liquid descending on or near the inner wall of the exchange column without collecting a substantial portion of the liquid in a second flow of the liquid descending in the exchange column away from the inner wall;

a transmission means for transmitting at least a portion of the collected liquid by the wall-flow collector toward the longitudinal axis away from the inner perimeter of the inner wall a substantial distance across the cross-sectional area of the exchange column; and

a dispensing means for dispensing at least a portion of the portion of the collected liquid from the transmission means to the layer of structured packing at a plurality of locations spaced apart over the substantial distance across the cross-sectional area of the exchange column.

14. (currently amended) A method for collecting and redistributing a first flow of a liquid descending on or near an inner wall of in an exchange column to a layer of structured packing disposed in the exchange column, the exchange column having a longitudinal axis, a cross-sectional area, and an inner wall having an inner perimeter, comprising the steps of:

introducing the liquid into the exchange column at a first location;

positioning a the layer of structured packing in the exchange column below the first location, the layer of structured packing having an exterior surface spaced apart from the inner perimeter of the inner wall;

positioning a wall-flow collector in the exchange column above the layer of structured packing and below the first location, the wall-flow collector having an outer perimeter adjacent the inner perimeter of the inner wall and being adapted to collect at least a portion of the liquid in the first flow of the liquid descending on or near the inner wall of the exchange column without collecting a substantial portion of the liquid in a second flow of the liquid descending in the exchange column away from the inner wall;

positioning a transmission means in the exchange column adjacent the wall-flow collector, the transmission means adapted to transmit at least a portion of the collected liquid collected by the wall-flow collector toward the longitudinal axis away from the inner perimeter of the inner wall a substantial distance across the cross-sectional area of the exchange column;

collecting in the wall-flow collector at least a portion of the liquid in the first flow of the liquid descending on or near the inner wall without collecting the substantial portion of the liquid in the second flow of the liquid descending in the exchange column away from the inner wall; and

transmitting a substantial portion of the collected liquid collected in the wall-flow collector toward the longitudinal axis away from the inner perimeter of the inner wall a substantial distance across the cross-sectional area of the exchange column;

providing a dispensing means for dispensing at least a portion of the portion of the collected liquid from the transmission means to the layer of structured packing at a plurality of locations spaced apart over the substantial distance across the cross-sectional area of the exchange column; and

dispensing the at least a portion of the portion of the collected liquid from the transmission means to the layer of structured packing at the plurality of locations.

15. (withdrawn) A process for cryogenic air separation comprising contacting a flow of a descending liquid and a counter-current flow of an ascending vapor in at least one distillation column containing at least one mass transfer zone, wherein liquid-vapor contact is established by at least one layer of structured packing, and wherein at least a portion of the flow of the descending liquid is collected and redistributed to the structured packing by an apparatus as in claim 1.

16. (withdrawn) A method for assembling an apparatus for collecting and redistributing a flow of a liquid descending in an exchange column to a layer of structured packing in the exchange column,

the exchange column having a longitudinal axis, a cross-sectional area, and an inner wall having an inner perimeter, comprising the steps of:

providing the exchange column;

providing the layer of structured packing in the exchange column, the layer of structured packing having an exterior surface spaced apart from the inner perimeter of the inner wall;

installing a wall-flow collector in the exchange column above the layer of structured packing, the wall-flow collector having an outer perimeter adjacent the inner perimeter of the inner wall and being adapted to collect at least a portion of the liquid descending on or near the inner wall of the exchange column;

installing a transmission means in the exchange column for transmitting at least a portion of the collected liquid collected by the wall-flow collector toward the longitudinal axis a substantial distance across the cross-sectional area of the exchange column; and

installing a dispensing means for dispensing the at least a portion of the portion of the collected liquid from the transmission means to the layer of structured packing.

17. (new) An apparatus for collecting and redistributing to a first layer of structured packing disposed in an exchange column a flow of a first liquid descending on or near an inner wall of the exchange column, the exchange column having a longitudinal axis and a cross-sectional area, the inner wall having an inner perimeter, and the exchange column containing the first layer of structured packing and a second layer of structured packing above the first layer of structured packing, each of the first and second layers of structured packing having an exterior surface spaced apart from the inner perimeter of the inner wall, comprising:

a wall-flow collector disposed in the exchange column above the first layer of structured packing and below the second layer of structured packing, the wall-flow collector having an outer perimeter adjacent the inner perimeter of the inner wall and being fixedly attached to the inner wall and adapted to collect at least a portion of the liquid in the first flow of the liquid descending on or near the inner wall of the exchange column without collecting a substantial portion of the liquid in a second flow of the liquid descending in the exchange column away from the inner wall;

at least one beam disposed in the exchange column between the first layer of structured packing and the second layer of structured packing, the beam adapted to support at least a portion of the second layer of structured packing and the beam having a first end,

a second end opposite the first end, and an elongated channel, having an open top and a floor, between the first end and the second end, the elongated channel being in fluid communication with the wall-flow collector and adapted to transmit at least a portion of the collected liquid collected by the wall-flow collector away from the inner perimeter of the inner wall a substantial distance across the cross-sectional area of the exchange column; and

a plurality of apertures in the floor of the channel of the beam for dispensing at least a portion of the collected liquid from the channel of the beam to the first layer of structured packing at a plurality of locations spaced apart over the substantial distance across the cross-sectional area of the exchange column.

18. (new) An apparatus as in claim 17, further comprising:

at least one wiper adjacent the inner perimeter of the inner wall of the exchange column, the wiper being located above the beam and adapted to transfer at least a portion of the liquid in the first flow of the liquid descending on or near the inner wall into the channel of the beam.

19. (new) An apparatus for collecting and redistributing to a first layer of structured packing disposed in an exchange column a first flow of a liquid descending on or near an inner wall of the exchange column, the exchange column having a longitudinal axis and a cross-sectional area, the inner wall having an inner perimeter, and the exchange column containing the first layer of structured packing and a second layer of structured packing above the first layer of structured packing, each of the first and second layers of structured packing having an exterior surface spaced apart from the inner perimeter of the inner wall, comprising:

a wall-flow collector disposed in the exchange column above the first layer of structured packing and below the second layer of structured packing, the wall-flow collector having an outer perimeter adjacent the inner perimeter of the inner wall and being movable in a vertical direction along the longitudinal axis within the exchange column and adapted to collect at least a portion of the liquid in the first flow of the liquid descending on or near the inner wall of the exchange column without collecting a substantial portion of the liquid in a second flow of the liquid descending in the exchange column away from the inner wall;

at least one beam disposed in the exchange column between the first layer of structured packing and the second layer of structured packing, the beam adapted to support at least a portion of the second layer of structured packing and the beam having a first end,

a second end opposite the first end, and an elongated channel, having an open top and a floor, between the first end and the second end, the elongated channel being in fluid communication with the wall-flow collector and adapted to transmit at least a portion of the collected liquid collected by the wall-flow collector away from the inner perimeter of the inner wall a substantial distance across the cross-sectional area of the exchange column; and

a plurality of apertures in the floor of the channel of the beam for dispensing at least a portion of the collected liquid from the channel of the beam to the first layer of structured packing at a plurality of locations spaced apart over the substantial distance across the cross-sectional area of the exchange column.

20. (new) An apparatus as in claim 19, further comprising:

at least one wiper adjacent the inner perimeter of the inner wall of the exchange column, the wiper being located above the beam and adapted to transfer at least a portion of the liquid in the first flow of the liquid descending on or near the inner wall into the channel of the beam.

21. (new) An apparatus as in claim 1, wherein a plurality of the plurality of locations are located a substantial distance from the inner perimeter of the inner wall.